ORIGINAL RESEARCH

Impact of the COVID-19 Pandemic on U.S. Pulmonary and Critical Care Medicine Fellowship Training

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Background: Although it is well known that the coronavirus disease (COVID-19) pandemic has had a profound effect on health care, its impact on fellowship training in Pulmonary and Critical Care Medicine (PCCM) has not been well described.

Objective: We conducted an anonymous survey of PCCM program directors (PDs) to assess the impact of the COVID-19 pandemic on PCCM fellowship training across the United States.

Methods: We developed a 30-question web-based survey that was distributed to U.S. PCCM PDs through the Association of Pulmonary and Critical Care Medicine Program Directors.

Results: The survey was sent to 242 PDs, of whom 28.5% responded. Most of the responses (76.8%) came from university-based programs. Almost universally, PDs reported a decrease in the number of pulmonary function tests (100%), outpatient visits (94.1%), and elective bronchoscopies (96%). Three-quarters (77.6%) of the PDs reported that their PCCM fellows spent more time in the intensive care unit than originally scheduled.

Conclusion: The COVID-19 pandemic has had a variable impact on different aspects of fellowship training. PDs reported a significant decrease in the core components of pulmonary training, whereas certain aspects of critical care training increased. It is likely that targeted mitigation strategies will be needed to ensure no gaps in PCCM training while optimizing well-being.

Keywords:
COVID-19; PCCM fellowship; training

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Globally, there have been nearly 180 million cases of coronavirus disease (COVID-19) since it was initially recognized in January 2020 (1). The United States accounts for nearly one-fifth of these cases, with over 600,000 deaths at the time of writing (1).

Approximately 5–20% of patients with COVID-19 develop critical illness requiring admission to the intensive care unit (ICU) (2–4). During the peak of the pandemic, hospitals across the country were overwhelmed, and ICUs were inundated with patients with COVID-19 (5). Meanwhile, several measures to reduce the transmission risk resulted in a reduction in pulmonary outpatient visits (6). National societies issued guidelines or recommendations related to aerosol-generating procedures that increase the risk of transmission of respiratory infections, including postponing elective bronchoscopies (7), limiting pulmonary function testing (PFT) (8–10), and having the most experienced operators intubate patients with known or suspected COVID-19 (11, 12). These changes directly or indirectly impacted the education and training of Pulmonary and Critical Care Medicine (PCCM) fellows. A recently published survey of interventional pulmonology fellows showed a decline in the number of procedures performed during the pandemic, especially therapeutic bronchoscopy, but the overall impact on training is unclear (13). The effect of the pandemic on general PCCM fellowship training is unknown.

We conducted an anonymous survey of PCCM Program Directors (PDs) across the country to assess the impact of changes owing to the COVID-19 pandemic on the education and training of PCCM fellows.

METHODS

We developed a survey using an internet-based electronic data collection tool (Research Electronic Data Capture) hosted at the Albert Einstein Medical Center in Philadelphia (14). We chose to survey the PDs for this study, as we felt that they would provide information regarding the fellowship program as a whole. Moreover, there is an established process to survey PDs through the Association of Pulmonary and Critical Care Medicine Program Directors (APCCMPD), whereas no such mechanism exists to survey all PCCM fellows systematically.

The survey consisted of 30 questions divided into seven categories designed to assess PDs' perspectives on the impact of COVID-19 on various aspects of fellowship training during the peak of the pandemic at their institution (*see* data

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supplement). It was created and iteratively revised by the authors, with review by the APCCMPD survey committee. It was distributed to 242 PDs registered with the APCCMPD on October 6, 2020, by the APCCMPD survey committee. Two reminder emails were sent at 2-week intervals, and the survey was closed on November 30, 2020. Survey responses were anonymous, and no identifiable information was obtained. This study was reviewed and determined to be exempt by the Institutional Review Board at the Albert Einstein Medical Center in Philadelphia (IRB-2020-483).

Descriptive data from survey responses are presented as the total number of responses and percentage of total respondents.

RESULTS

Of the 242 PDs who received the survey, 69 completed it for a 28.5% response rate. We did not include 18 incomplete responses that had more than 50% of the questions unanswered. The majority of the PDs who responded to the survey belonged to a university-based program (76.8%) or a community-based university-affiliated program (15.9%). There was reasonable representation from all the regions of the United States. Figure 1A shows regional distribution of participating programs together with the total number of programs in each region. The distribution of the total number of fellows in the participating programs is shown in Figure 1B.

Impact on Pulmonary Training

All the PDs reported a decrease in number of PFTs performed at their institution at the peak of the pandemic (Figure 2). Also, the number of outpatient visits for fellows (including longitudinal, subspecialty, and elective clinics occurring in person or via telehealth) decreased in 94.1% of the programs (Figure 2). Very few PDs reported no change in the number of outpatient visits (5.9%).

Almost all the PD responders (95.6%) observed a decrease in the number of elective bronchoscopies performed at their institution at the peak of the pandemic (Figure 2). The majority of PDs (85.1%) reported that their graduating fellows were able to graduate with at least 100 bronchoscopies. Only three programs (4.5%) had one or more fellows who were unable to graduate with at least 100 bronchoscopies. The remaining seven PDs (10.4%) did not know how many of their fellows graduated with fewer than 100 bronchoscopies. The majority of PDs (52.2%) reported a decline in the proportion of elective bronchoscopies performed under moderate sedation, whereas a significant number reported no change (39.1%). A minority (15.9%) reported an increase in the proportion of elective bronchoscopies performed under general anesthesia.

Pleural procedures including thoracentesis and chest tube insertions did not change in the majority of programs (65.7% and 52.2%, respectively). Overall, 32.8% of programs reported an increase in the number of chest tube insertions performed by the fellows.

Impact on Critical Care Training

About three-quarters (77.6%) of the PDs reported that their PCCM fellows spent more time on ICU rotations than originally scheduled. The majority of PDs reported an increase in the number of common ICU procedures performed by the fellows, such as central venous

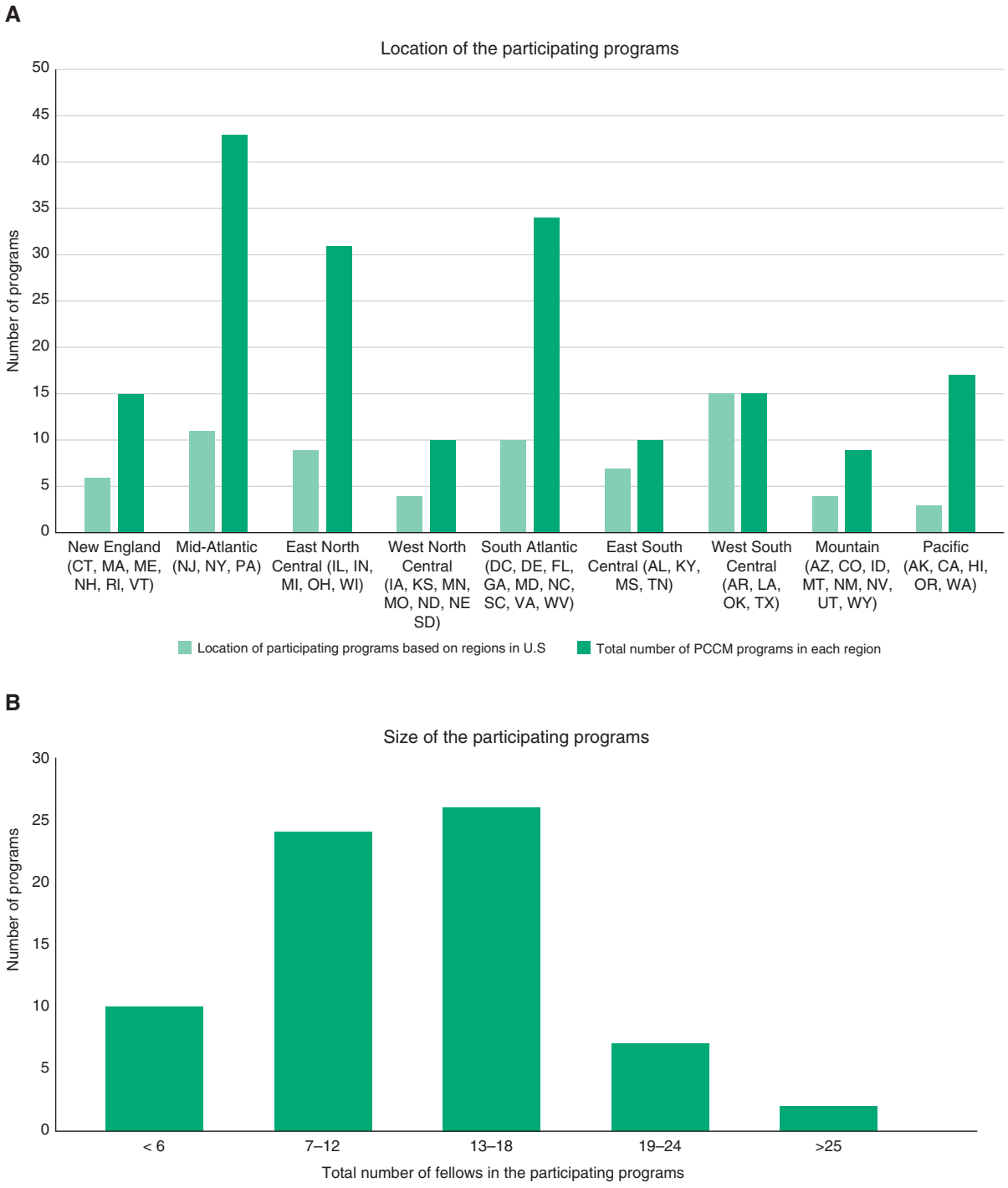

Figure 1. (*A*) Location of the participating programs. (*B*) Size of the participating programs. PCCM=Pulmonary and Critical Care Medicine.

catheter (52.2%) and arterial catheter (55.2%) insertions. The majority reported a decrease in the number of aerosol-generating procedures performed by the fellows (Figure 2), including intubations (62.7%), percutaneous tracheostomies (38.8%), and ICU bronchoscopies (49.3%).

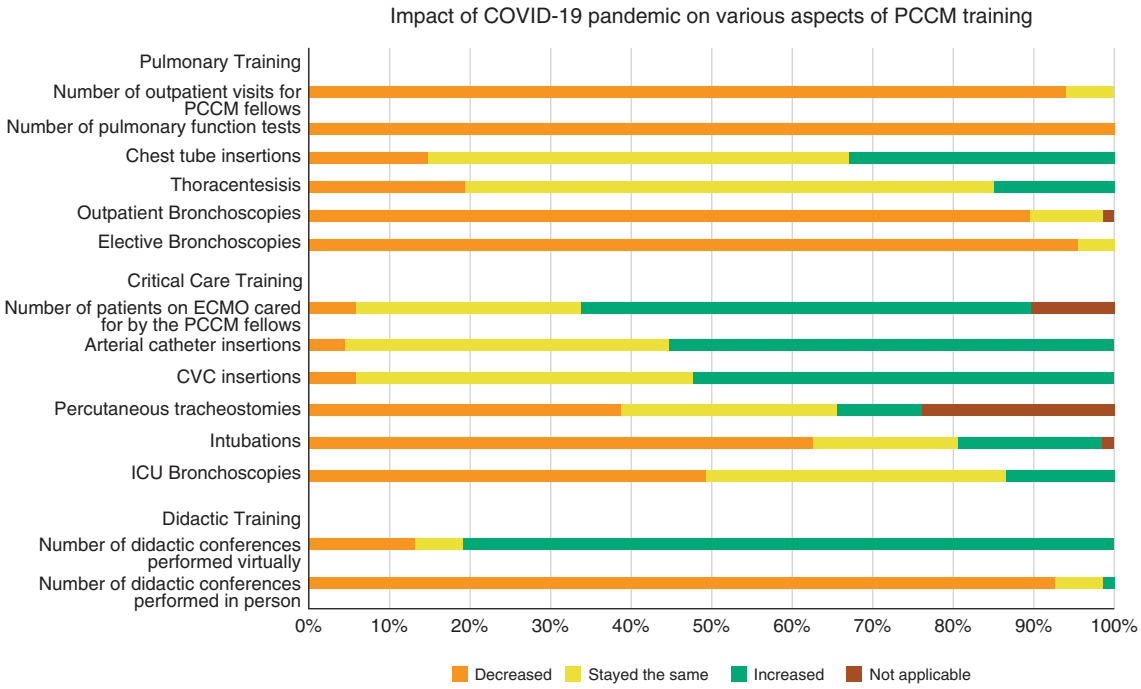

Figure 2. Impact of the coronavirus disease (COVID-19) pandemic on various aspects of PCCM training. CVC = central venous catheter; ECMO = extracorporeal membrane oxygenation; ICU = intensive care unit; PCCM = Pulmonary and Critical Care Medicine.

The number of patients on extracorporeal membrane oxygenation cared for by PCCM fellows increased in 55.8% of programs, remained unchanged in 27.9%, and decreased in 6.1% (Figure 2).

Impact on Didactic Training

The majority of PDs reported a decrease in in-person (92.6%) and increase in virtual conferences (teaching sessions) (80.9%).

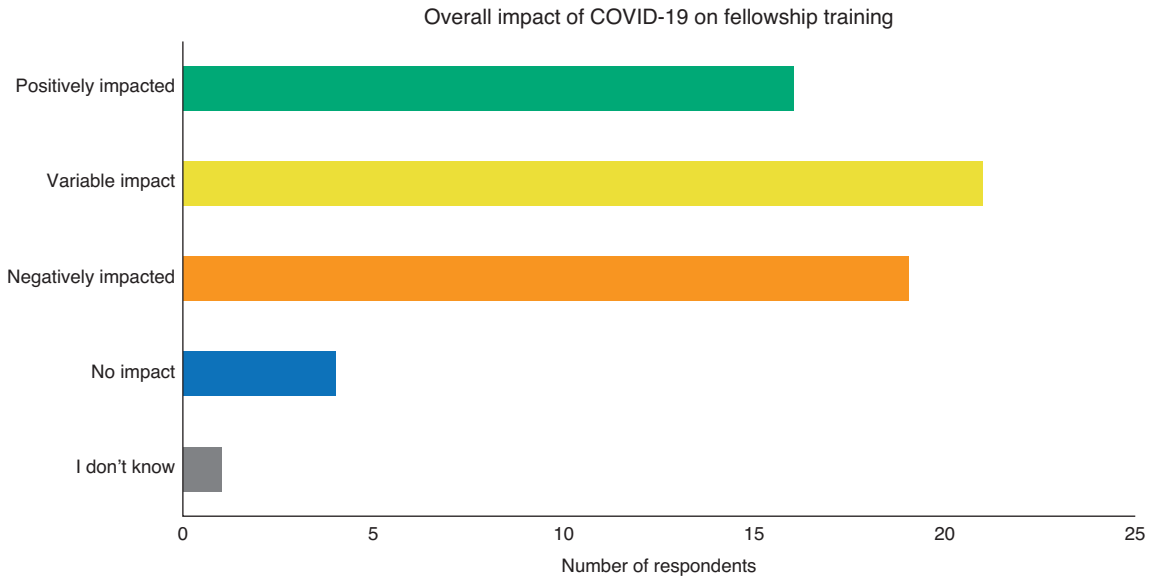

Figure 3. Overall impact of coronavirus disease (COVID-19) on fellowship training.

Table 1. Additional changes in fellowship education or mitigation strategies

Schedule and Work Hours
• More in-house attending coverage • We did change our schedule around and instituted a temporary night float system. We also tried to give the fellows at least two days off a week during the week if they worked the weekend days, so just shifted their schedule around. • We used other services more, and now our APPs are primarily doing COVID with attendings to give the fellows a break. Have also decreased their night coverage to mitigate burnout. • Workload compression and ICU service size.
Education
• Incorporated more simulation training for bronchoscopy and critical care procedures. • More reliance on virtual conferences since the peak. Greater role of telemedicine and greater awareness of public health.
Communication
• Regular virtual check ins with the fellows, COVID specific journal clubs and didactics, increase in telehealth visits. • Ongoing process, meetings among PD are happening to decide best approach on how to assess burnout. • More frequent communication, more contiguous days off when on difficult ICU rotations. • More "minibreaks" with fellows and PD (breakfast, lunch, snacks, coffee time, random conversations in the fellow's area to check in on them). • Created a fellow working group to make recommendations on virtual education and give feedback. • We conducted frequent group and individual check in, with PD, APD and with fellow peers. We established a reporting system for fellows to check on each other for signs of burnout. We also used established instruments when needed.

Definition of abbreviations: APD = Associate Program Director; APPs = Advanced Practice Providers; COVID = coronavirus disease; ICU = intensive care unit; PD = Program Director.

Overall Impact

As shown in Figure 3, the most common responses for overall impact of the COVID-19 pandemic on fellowship training in PCCM were variable (34.4%) or negative (31.1%). Fewer PDs stated that the overall impact was either positive (26.2%) or it had no impact (6.6%). Free text responses outlining additional changes to PCCM fellowship programs as a result of the pandemic are listed in Table 1. These responses followed three broad themes of changes in education, schedule, and communication and have been categorized as such.

DISCUSSION

The COVID-19 pandemic has had an extraordinary impact on the healthcare system globally, and this, in turn, has also impacted medical education (15). The results of this survey suggest that the COVID-19 pandemic has weakened several core aspects of pulmonary training, whereas it has enhanced some core aspects of critical care training.

Procedural training accounts for a significant portion of PCCM fellowship training, as fellows are expected to gain expertise in bronchoscopy, airway management, and various ICU

procedures, such as central venous catheter and arterial catheter insertion (16). The majority of PDs reported a decrease in the number of elective and ICU bronchoscopies performed at their institution. Bronchoscopy is an aerosol-generating procedure with a significant risk of viral transmission (17). Several national societies issued guidelines (or recommendations) to postpone elective bronchoscopies, and their impact is reflected in our results (7). At the majority of institutions that responded, PCCM fellow experience with other aerosol-generating procedures, such as endotracheal intubation and percutaneous tracheostomy, also decreased. This is consistent with recommendations that these procedures be performed by the most experienced clinician to minimize exposure and to preserve personal protective equipment (11, 12).

Despite the decline in the number of bronchoscopies performed, the majority of programs were able to graduate their fellows with at least 100 bronchoscopies as recommended by the American College of Chest Physicians (18). This might be due to the fact that the pandemic occurred during the last 6 months of training for graduating senior fellows, who likely had already completed the majority of their required clinical experience. As the pandemic continues and affects fellows earlier in their training, achieving 100 bronchoscopies before graduation may become more difficult. The updated Accreditation Council for Graduate Medical Education program requirements for PCCM do not specify a number requirement for competency in bronchoscopies for graduating fellows, as they focus on competency-based evaluation of fellows by the PD together with the Clinical Competency Committee (16). Nonetheless, procedural comfort for independent practice has been shown to be dependent on the number of procedures performed during training (19). During the COVID-19 pandemic, one major center transitioned to performing all bronchoscopies under general anesthesia in an attempt to minimize the risk of virus aerosolization (20). However, the results of this survey suggest this was not a common approach.

Our study found that the COVID-19 pandemic had a substantial impact on outpatient training of PCCM fellows. Nearly all the PDs reported a decline in the number of outpatient clinic visits for the fellows, both virtual/telehealth and in-person visits. This, in turn, might have contributed to the decline in the number of elective and outpatient bronchoscopies owing to a decrease in the number of referrals. Also, all the PDs reported a decline in the number of PFTs being performed at their institution. This was in line with the guidelines issued by various societies around the world that recommended canceling or postponing elective PFTs during the peak of the pandemic (8–10).

The number of pleural procedures performed essentially remained the same. A similar finding was noted in the survey study from the interventional pulmonology group (13). This could possibly relate to the fact that pleural procedures are generally unavoidable, as they are both diagnostic and therapeutic. Also, the risk of viral transmission with pleural procedures is low, as they are not aerosol generating. Almost one-third of the PDs in our study reported an increase in the number of chest tube insertions by the fellows. This could be secondary to the increased incidence of barotrauma in patients with COVID-19, resulting in pneumothorax and pneumomediastinum requiring chest tube placement (21).

Limitations

Our study has several limitations. The response rate of 28.5% is lower than the previously reported response rate among PDs in online surveys, which may have been due to increased workloads or stress experienced by PDs during the pandemic (22, 23). It is possible that nonresponders differ significantly and systematically from responders, leading to nonresponse bias. For example, the majority of responses were from university programs, limiting generalizability to community hospital–based programs. However, we did receive responses from every region of the country, including both small and large programs. Another potential reason for the low response rate was that the survey was distributed to all the PDs registered with APCCMPD, which includes PDs from PCCM, pulmonary-only, and critical care–only programs. However, our questions were directed at PCCM PDs, and so a number of the nonresponders may have been PDs of pulmonary- or critical care–only programs.

Additional limitations are that we surveyed only PDs who are members of APCCMPD, we did not collect objective data to assess the impact of COVID-19 on PCCM training, and we did not collect fellow perceptions of the impact of COVID-19 on training. These choices were made because the APCCMPD has a systematic process to survey PDs, whereas no such mechanism exists to survey all PCCM fellows systematically, and we hoped that PDs would be able to provide an overall perspective on all aspects of fellow training and education without having to collect procedure numbers from multiple institutions. Also, we did not collect information on the impact of the pandemic on research and scholarly activity.

Finally, we directed PDs to answer the survey according to the peak of the pandemic at their institution; however, the survey was completed in November 2020, and the peak case rate for the United States occurred in January 2021. Hence, this data may not be representative of the full impact of COVID-19 on PCCM training.

Conclusions

Despite the limitations, our study highlights important findings regarding fellowship training of PCCM fellows during this global crisis. Some core aspects of critical care training were augmented, such as increases in extracorporeal membrane oxygenation training, select ICU procedures, and increased ICU time. However, several core components of pulmonary training, including bronchoscopy, PFT interpretation, and outpatient clinic training, decreased. Since our survey, the country has faced several more months of the pandemic. Hence, it is crucial for the programs to develop strategies to ensure appropriate PCCM training. The free text responses from PDs provide additional valuable information regarding changes considered or implemented by individual programs. The major themes that emerged were frequent check-ins with the fellows, adjustment of work schedules to ensure adequate time off, and incorporation of virtual educational conferences together with simulation training. Although we will need additional data regarding their effectiveness, these may help inform future policies and changes.

Author disclosures are available with the text of this article at www.atsjournals.org.

REFERENCES

1. Johns Hopkins University. Coronavirus resource center. Baltimore, MD: Johns Hopkins University; 2021 [accessed 2021 June 28]. Available from: https://coronavirus.jhu.edu/map.html.

2. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, *et al.*; the Northwell COVID-19 Research Consortium. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA* 2020; 323:2052–2059.

3. Grasselli G, Pesenti A, Cecconi M. Critical care utilization for the COVID-19 outbreak in Lombardy, Italy: early experience and forecast during an emergency response. *JAMA* 2020;323:1545–1546.

4. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020;323:1239–1242.

5. Jacobo J, Mitropoulos A. Hospital ICUs running out of space due to COVID-19 surges across the country. ABC News; 2020 [accessed 2020 Nov 29]. Available from: https://abcnews.go.com/Health/hospital-icus-running-space-due-covid-19-surges/story?id=74169792.

6. Mehrotra A, Chernew ME, Linetsky D, Hatch H, Cutler DA, Schneider EC. The impact of the COVID-19 pandemic on outpatient care: visits return to prepandemic levels, but not for all providers and patients. The Commonwealth Fund; 2020 [accessed 2020 Nov 29]. Available from: https://www.commonwealthfund.org/publications/2020/oct/impact-covid-19-pandemic-outpatient-care-visits-return-prepandemic-levels.

7. Lentz RJ, Colt H. Summarizing societal guidelines regarding bronchoscopy during the COVID-19 pandemic. *Respirology* 2020;25:574–577.

8. McCormack MC, Kaminsky DA. Pulmonary Function Laboratories: advice regarding COVID-19. New York, NY: American Thoracic Society [accessed 2021 April 20]. Available from: https://www.thoracic.org/professionals/clinical-resources/disease-related-resources/pulmonary-function-laboratories.php.

9. Association for Respiratory Technology and Physiology (ARTP). ARTP COVID-19 update. ARTP; 2020 [accessed 2021 April 30]. Available from: https://www.artp.org.uk/News/artp-covid19-april2020.

10. Crimi C, Impellizzeri P, Campisi R, Nolasco S, Spanevello A, Crimi N. Practical considerations for spirometry during the COVID-19 outbreak: literature review and insights. *Pulmonology* [online ahead of print] 2020 Aug 5; DOI: 10.1016/j.pulmoe.2020.07.011.

11. American Society of Anesthesiologists. Recommendations when caring for patients with known or suspected COVID-19 infection. Washington, DC: American Society of Anesthesiologists [accessed 2021 May 5]. Available from: https://www.asahq.org/about-asa/governance-and-committees/asa-committees/committee-on-occupational-health/coronavirus.

12. Orser BA. Recommendations for endotracheal intubation of COVID-19 patients. *Anesth Analg* 2020;130:1109–1110.

13. Kalchiem-Dekel O, Schwalk AJ, Patel NM, Lin I-H, Beattie JA, Husta BC, *et al.* COVID-19 impact on interventional pulmonology training. *ATS Scholar* 2021;2:236–248.

14. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, *et al.*; REDCap Consortium. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform* 2019;95:103208.

15. Rose S. Medical student education in the time of COVID-19. *JAMA* 2020;323:2131–2132.

16. Accreditation Council for Graduate Medical Education (ACGME). ACGME program requirements for graduate medical education in pulmonary and critical care medicine. Chicago, IL: ACGME; 2020 [accessed 2020 Nov 20]. Available from: https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/156_PCCM_2020.pdf?ver=2020-06-29-162350-7872020.

17. Harding H, Broom A, Broom J. Aerosol-generating procedures and infective risk to healthcare workers from SARS-CoV-2: the limits of the evidence. *J Hosp Infect* 2020;105:717–725.

18. Ernst A, Silvestri GA, Johnstone D; American College of Chest Physicians. Interventional pulmonary procedures: guidelines from the American College of Chest Physicians. *Chest* 2003;123:1693–1717.

19. Knox DB, Wong WW. Graduating Fellows' procedural comfort level with pulmonary critical care procedures. *J Bronchology Interv Pulmonol* 2019;26:231–236.

20. Gildea TR, Abdelmalak BB. Bronchoscopy challenges during the COVID-19 pandemic. *Cleve Clin J Med* [online ahead of print] 2020 Aug 5; DOI: 10.3949/ccjm.87a.ccc054.

21. McGuinness G, Zhan C, Rosenberg N, Azour L, Wickstrom M, Mason DM, *et al.* Increased incidence of barotrauma in patients with COVID-19 on invasive mechanical ventilation. *Radiology* 2020;297:E252–E262.

22. Richards JB, McCallister JW, Lenz PH. Pulmonary and critical care medicine program directors' attitudes toward training in medical education: a nationwide survey study. *Ann Am Thorac Soc* 2016;13:475–480.

23. Natalini JG, Kassutto SM, Huie TJ, Kreider ME. Fellowship education in interstitial lung disease: a national survey of program directors and trainees. *ATS Scholar* 2020;1:384–394.